Boulder Creek Fuels Restoration Project Soil Analysis

Introduction

Fire has played an important role in the ecology of the Sierra Nevada for thousands of years. Before the area was settled by Euro-Americans, fires were generally frequent throughout much of the range. The natural landscape, soil, plant communities, and wildlife have developed/evolved in concert with the natural process of fire for at least the 10,000 years.

Management strategies in the twentieth century have reduced the influence of fires in the ecosystem and contributed to the forest conditions that encourage high-severity fires. Live and dead fuels increased along with the development of denser brush and mixed conifer forests. The majority of the Boulder Creek drainage in the project area has missed the last five fire return intervals (100+ years of fire exclusion).

The Hume Lake Ranger District proposes to use prescribed fire to reintroduce fire into the lower portion of the Boulder Creek drainage. The project area encompasses approximately 14,385 acres of the watershed, of which 6,000 to 9,000 acres would be proposed for under-burning.

Background/Surveys

The soils in the Boulder Creek Fuels Restoration Project area are primarily derived from solid bedrock, mostly igneous granite with smaller areas of metamorphic roof pendants. The lower elevations of the area (along the Kings River) have abundant rock outcrop and are more highly dissected into steep drainages and ridgelines. The higher elevations tend to have more subdued topography with more gentle basins and moderate slopes. The soil textures across the project are mostly sandy loams.

More than half of the soil associations within the project area are not soil at all, but are mapped as rock outcrop. The specific soil associations not dominated by rock outcrop are shown in the table below. The soil associations are shown with their approximate percentage by area within the project area, erosion hazard rating, predominant soil texture, and slope range. A high or very high rating means accelerated erosion can occur, and the need for erosion control measures should be evaluated, in light of a projects potential for soil disturbance.

Soil Associations with High and Very High Erosion Hazard within the Project Area

Soil Association	Chaix-Dome-Rock Outcrop	Hotaw-Brownlee-Rock Outcrop	Cannell-Kriest-Rock Outcrop
% of Project area	15%	20%	10%
Erosion hazard rating	Very High	High	Very High
Soil Texture	Sandy loam	Fine Sandy loam	Sandy Loam
Slopes	30-70 %	30-75 %	30-70%

This information above comes from the Sequoia National Forest Soil Survey. Most of the erosion hazard ratings for the soil associations within the project area are high to very high. Small inclusions of other soils total less than 20% (by area) within these soil associations. Inclusions within these tend to have similar characteristics as the association they occur with.

All of the above soil associations are found in the middle and higher elevations of the project area from 6,500 to 8,000 feet. The Chawanakee-Chaix and Cannell-Kriest associations are formed in residuum derived from granitic rock. The Hotaw-Brownlee association is formed in residuum derived from metamorphic rock. All of the areas given a high or very high erosion hazard rating by the soil survey are on steep ground, with slope ratings from 30 to 75 %.

Additionally, soil association descriptions from the soil survey and the treatment layout were field verified by Forest Service soil scientist, Fletcher Linton in the summer of 2012. The above three soil association profiles were evaluated in the field (in a qualitative manner) for consistency with the soil survey, amount of soil organic cover, and erosion potential. It was determined that the driving factor behind these soils having high and very high erosion hazard ratings is the natural steepness of the slopes.

Proposed Activities

The Hume Lake Ranger District proposes to use prescribed fire to reintroduce fire into the lower portion of the Boulder Creek drainage. The Boulder Creek Fuel Restoration Project proposes to treat the area with prescribed fire ignited on the ground with drip torches and from helicopters using potassium permanganate 'ping-pong' balls. Old fire lines, roads, and trails will be used as control lines and reinforced with crews, using hand tools. The project area encompasses approximately 14,385 acres of the watershed, of which 6,000 to 9,000 acres would be proposed for under-burning. The smaller amount of treatment acres is due to large areas of rock and other small features that would need other treatments prior to, or instead of, prescribed fire.

Soil Quality Standards

Forest soil quality standards are from the 1988 Sequoia National Forest Plan, as amended by the 2012 Giant Sequoia National Monument FEIS and Management Plan. :

- During management activities maintain an average of 50 percent effective soil cover in treatment areas that is well distributed and generally in the form of fine organic matter. Effective soil cover is that whose thickness and continuity provides adequate protection to prevent rill network formation. Fine organic matter includes plant litter, duff, and woody material less than 3 inches in diameter. Management activities in areas with ecological types that cannot normally support 50 percent soil cover will need to be considered individually for soil cover needs. In special areas such as fuelbreaks and defense zones, immediate post-treatment soil cover levels less than 50 percent will be allowed as long as the site conditions and actual cover level will prevent erosion. Field review and monitoring should be used to determine the minimal level of soil cover necessary in special areas.

- Maintain 100 percent soil cover in a 100-foot-wide buffer below rock outcrops that have the potential to generate runoff into management activity areas and cause erosion.
- In areas where sustained slopes exceed 35 percent, limit mechanical operations such as skidding, tractor piling, grapple piling, and mastication, except where supported by on-the-ground evaluation by an interdisciplinary team that includes a watershed specialist.
- Limit total soil compaction (displacement and total soil porosity reduction) to less than 15 percent of the management activity area. No more than 10 percent of the activity area can be displaced. Temporary roads, temporary landings, and skid trails will be considered part of the activity area to evaluate. Areas excluded from this standard include National Forest System roads, trails, and facilities, and other dedicated sites.

  Soil will be considered displaced if more than one-half of the thickness of the topsoil or A horizon has been removed from a contiguous area larger than 100 sq. ft. Soil will be considered compacted if there is less than 90 percent total soil porosity in a contiguous area greater than 100 sq. ft compared to undisturbed soils nearby.

  Conduct operations when soil porosity, especially macroporosity, will be maintained at a level sufficient for soil hydrologic function and long-term soil productivity for plant growth. Use the latest findings of studies such as that for Long Term Soil Productivity by Powers to evaluate the effects to soil productivity from porosity changes.
- Maintain aquic soil moisture conditions (defined in Soil Taxonomy) in wet meadows and fens. Areas with aquic soil moisture conditions include wet meadows and fens where soil moisture levels remain high throughout most of the year.

  Maintain soil structure and porosity. Use the presence and density of water-dependent vegetation as indicators of soil moisture condition.
- Maintain downed logs for soil organisms, based upon the ecological type and in consultation with wildlife and fuels.
- For projects involving the application of chemicals, such as herbicides, pesticides, or other amendments, evaluate the effects to soil micro-organisms, post-project erosion risk, leaching potential, and risk of off-site movement of the chemicals. Provide recommendations to prevent adverse effects.

Analysis/Conclusion

Soil Quality Standards and Guidelines were primarily developed to address the effect of mechanical soil disturbance. Because all of the work associated with this project uses hand crews and helicopters, the mechanical soil disturbance from this project can be discounted as negligible. The soil disturbance at issue in this project is the different effects on soil cover and the physical properties of soil by prescribed fire.

The consumption of soil cover (intact/decomposed leaves, needles, and wood) during the proposed action (fall prescribed burns) will be more discontinuous and incomplete, as compared to a wildfire during the summer. This will leave more litter on the ground and will help soil be less vulnerable to post-fire runoff and erosion, by intercepting and absorbing precipitation. The discontinuity of areas with more complete consumption will minimize the post-treatment concentration of runoff into rills and gullies, thus reducing erosion, as well.

Prescribed fire can be expected to have less adverse effects on soil structure than wildfire. The most important soil physical characteristic affected by fire is soil structure because the organic matter component is lost at relatively low temperatures. The loss of soil structure increases the bulk density of the soil thus reducing its porosity, thereby reducing soil productivity and making the soil more vulnerable to post-fire runoff and erosion. The prescribed fire treatment will result in less overall severe fire behavior (than wildfire) and less heat transfer into the soil, which will reduce fire damage to soil structure, preserving soil quality in the project area.

Prepared/Approved by Fletcher Linton, Soil Scientist/Botanist, Sequoia National Forest.

/s/ Fletcher Linton 11/15/12